

10/500794
DT04 Rec'd PCT/PTO 07 JUL 2004**Amendments to the Claims**

Please amend Claims 1-21 and 23-24. Please add new Claims 25-30. The Claim Listing below will replace all prior versions of the claims in the application:

Claim Listing

1. (Currently Amended) A sensing arrangement having a sensor device and amplifier circuitry, the sensor device being constructed and arranged to provide a sensor signal when it receives ~~[[or]]~~ one or more charged particles and/or one or more quanta of electromagnetic radiation, the amplifier circuitry having an input node and an output node, the sensor device being connected to said input node for supplying said signal thereto whereby ~~[[the]]~~ a level at the output node changes, and further having feedback circuitry connecting said input node and said output node for feeding back a portion of the level at the output node for maintaining a first level at the output node in the absence of a said signal from said sensor device, the feedback device being responsive to ~~[[the]]~~ a change in level ~~[[of]]~~ at said output node to vary ~~[[the]]~~ an effect of said feedback circuitry when said level changes to increase ~~[[the]]~~ a loop gain of said amplifier circuitry.
2. (Currently Amended) ~~[[A]]~~ The sensing arrangement ~~according to~~ of claim 1, wherein the feedback circuitry comprises a dc path and capacitive path, and ~~[[the]]~~ a capacitance of the capacitive path reduces substantially to zero when the level at the output node is close to a threshold level.
3. (Currently Amended) ~~[[A]]~~ The sensing arrangement ~~according to~~ of claim 1 ~~or claim 2~~ wherein the feedback circuitry comprises a MOSFET, having a drain source path connecting said input node and said output node, said MOSFET having a gate connected to a reference potential.
4. (Currently Amended) ~~[[A]]~~ The sensing arrangement ~~according to~~ of claim 3, wherein said amplifier circuitry is arranged to have an output node level which changes in response to a said signal sufficiently to cause ~~[[the]]~~ a drain current of the said

MOSFET to fall to zero, whereby the amplifier circuitry operates in an open-loop condition.

5. (Currently Amended) ~~[[A]]~~ The sensing arrangement ~~according to~~ of claim 3 ~~[[or 4]]~~, having an input current source constructed and arranged to apply a current to said input node of said amplifier, wherein said MOSFET is operable to provide a path from said input node to carry said current to said output node whereby said MOSFET is maintained in deep weak inversion.
6. (Currently Amended) ~~[[A]]~~ The sensing arrangement ~~according to~~ of claim 5 wherein the current source comprises a current mirror.
7. (Currently Amended) ~~[[A]]~~ The sensing arrangement ~~according to~~ of claim 3 ~~, 4, 5 or 6~~, having an output transistor having a gate connected to said output node for providing an output signal indicating detection of a said charged particle and/or electromagnetic radiation, wherein said reference voltage determines the level of said sensor signal required to provide said output signal to allow single particle detection.
8. (Currently Amended) ~~[[A]]~~ The sensing arrangement ~~according to~~ of claim 5 ~~[[or 6]]~~, in which the input current source is constructed and arranged to be controllable to a value of substantially zero to allow integration by said amplifier circuitry of sensed charge of said sensor device signal with the amplifier circuitry in open-loop condition, wherein the amplifier circuitry has a source follower output for providing an analog~~[[ue]]~~ output.
9. (Currently Amended) A sensing arrangement having a sensor device and amplifier circuitry, the sensor device being constructed and arranged to provide a sensor signal when it receives ~~[[or]]~~ one or more charged particles and/or one or more quanta of electromagnetic radiation, the amplifier circuitry having an input node and an output node, the sensor device being connected to said input node for supplying said signal thereto whereby ~~[[the]]~~ a level at the input node changes and causes an output signal from said output node, the sensor arrangement further comprising a current mirror

connected to said input node and constructed and arranged to supply current thereto for restoring the level at the input node to a starting level.

10. (Currently Amended) ~~[[A]]~~ The sensing arrangement ~~according to any preceding of~~ claim 1, ~~the arrangement being~~ integrated on a semiconductor substrate.
11. (Currently Amended) A sensing arrangement comprising a sensor device for detecting arrival of an incident quantum of electromagnetic radiation and/or charged particles, and an amplifier connected to the sensor device for amplifying a signal from the sensor device, wherein the sensor device and the amplifier are fabricated on a common substrate, the arrangement being constructed and arranged to discriminate between ~~[[the]]~~ arrival of single ~~[[or]]~~ and multiple incident quanta at the sensor device.
12. (Currently Amended) ~~[[A]]~~ The sensing arrangement ~~according to any preceding of~~ claim 1, wherein the sensor device comprises one or more selected from the group comprising a p-n junction sensor, a p-n photodiode, an avalanche photodiode, a radiation sensor for detecting charged particles and/or X-ray photons, an amorphous Si:H PIN diode, and a high atomic number semiconductor PIN diode.
13. (Currently Amended) ~~[[A]]~~ The sensing arrangement ~~according to any preceding of~~ claim 1, wherein the sensing arrangement is a pixel cell.
14. (Currently Amended) ~~[[A]]~~ The sensing arrangement ~~according to any preceding of~~ claim 1 further comprising a readout circuit comprising complementary metal oxide semiconductor (CMOS) circuitry for receiving the output of the sensor device and producing an output signal corresponding to ~~[[said]]~~ a detection event.
15. (Currently Amended) ~~[[A]]~~ The sensing arrangement ~~according to any preceding of~~ claim 1, wherein a quantum provides an input charge to the sensor device, wherein the input charge is around 10 to 15 e- at a reference current of around 10pA.

16. (Currently Amended) ~~[[A]]~~ The sensing arrangement according to claim 7 or any claim dependent on of claim 7, wherein ~~[[the]]~~ having a voltage potential [[is]] arranged to bias the output transistor in weak inversion at a drain current of few nanoamps.
17. (Currently Amended) ~~[[A]]~~ The sensing arrangement according to claim 7 or any claim dependent on of claim 7, wherein the drain current increase of the output transistor is 1000 times (3 current decades) its value between around 1nA to 1 A for an output voltage increase of the amplifier circuitry of about 250 mV.
18. (Currently Amended) ~~[[A]]~~ The sensing arrangement according to any preceding of claim 1, wherein an output voltage increase of about 250 mV is generated by an input charge of about 25 e-.
19. (Currently Amended) A detection system comprising an array of sensing arrangements ~~according to any preceding claim~~, having a sensor device and amplifier circuitry, the sensor device being constructed and arranged to provide a sensor signal when it receives one or more charged particles and/or one or more quanta of electromagnetic radiation, the amplifier circuitry having an input node and an output node, the sensor device being connected to said input node for supplying said signal thereto whereby a level at the output node changes, and further having feedback circuitry connecting said input node and said output node for feeding back a portion of the level at the output node for maintaining a first level at the output node in the absence of a said signal from said sensor device, the feedback device being responsive to the change in level of said output node to vary the effect of said feedback circuitry when said level changes to increase the loop gain of said amplifier circuitry, the detection system comprising a readout circuit for receiving [[the]] an output of the sensing arrangements sensor devices and producing an output signal corresponding to said detection.
20. (Currently Amended) A macropixel comprising an array of sensing arrangements ~~according to any preceding claim~~, each having a sensor device and amplifier circuitry,

each sensor device being constructed and arranged to provide a sensor signal when it receives one or more charged particles and/or one or more quanta of electromagnetic radiation, the amplifier circuitry having an input node and an output node, the sensor device being connected to said input node for supplying said signal thereto whereby a level at the output node changes, and further having feedback circuitry connecting said input node and said output node for feeding back a portion of the level at the output node for maintaining a first level at the output node in the absence of a said signal from said sensor device, the feedback device being responsive to the change in level of said output node to vary the effect of said feedback circuitry when said level changes to increase the loop gain of said amplifier circuitry, wherein [[the]] outputs of said sensing arrangements ~~sensor devices~~ are combined to give the effect of a larger pixel.

21. (Currently Amended) [[A]] The macropixel according to ~~of~~ claim 20 wherein the outputs of the sensing arrangements ~~sensor devices~~ are connected to a bus.
22. (Original) A method of detecting the arrival of one or more charged particles and/or one or more quanta of electromagnetic radiation using a sensing circuit comprising a sensor device, and amplifier circuitry, wherein the sensor device is connected to an input node of the amplifier circuitry and is constructed and arranged to provide a signal when it receives said one or more charged particles and/or one or more quanta of electromagnetic radiation, the method comprising:
 - feeding back a portion of an output voltage at an output node of said amplifier circuitry to said input node; amplifying the voltage at said input of said amplifier circuitry, whereby the voltage at the output node increases; and
 - in response to said increase in voltage, reducing the portion of said output voltage that is fed back to increase the loop gain of said amplifier circuitry.
23. (Currently Amended) [[A]] The method according to ~~of~~ claim 22, further comprising decreasing a capacitance between said output node and said input node as the voltage at the output node increases.

24. (Currently Amended) [[A]] The method according to of claim 22 [[or 23]], comprising reducing said feedback to zero whereby the amplifier circuitry operates in an open-loop condition.
25. (New) A detection system comprising an array of sensing arrangements each having a sensor device and amplifier circuitry, each sensor device being constructed and arranged to provide a sensor signal when it receives one or more charged particles and/or one or more quanta of electromagnetic radiation, the amplifier circuitry having an input node and an output node, the sensor device being connected to said input node for supplying said signal thereto whereby the level at the input node changes and causes an output signal from said output node, the arrangement further comprising a current mirror connected to said input node and constructed and arranged to supply current thereto for restoring the level at the input node to a starting level, the detection system comprising a readout circuit for receiving an output of the sensing arrangements and producing an output signal.
26. (New) A macropixel comprising an array of sensing arrangements, each having a sensor device and amplifier circuitry, each sensor device being constructed and arranged to provide a sensor signal when it receives one or more charged particles and/or one or more quanta of electromagnetic radiation, the amplifier circuitry having an input node and an output node, the sensor device being connected to said input node for supplying said signal thereto whereby the level at the input node changes and causes an output signal from said output node, the arrangement further comprising a current mirror connected to said input node and constructed and arranged to supply current thereto for restoring the level at the input node to a starting level, wherein outputs of said sensing arrangements are combined to give the effect of a larger pixel.
27. (New) The macropixel of claim 26 wherein the outputs of the sensing arrangements are connected to a bus.
28. (New) A detection system comprising an array of sensing arrangements, each sensing arrangement comprising a sensor device for detecting arrival of an incident quantum

of electromagnetic radiation and/or charged particles, and an amplifier connected to the sensor for amplifying a signal from the sensor, wherein the sensor and the amplifier are fabricated on a common substrate, the arrangement being constructed and arranged to discriminate between the arrival of single or multiple incident quanta at the sensor device, the detection system comprising a readout circuit for receiving an output of the sensing arrangements and producing an output signal.

29. (New) A macropixel comprising an array of sensing arrangements, each sensing arrangements comprising a sensor device for detecting arrival of an incident quantum of electromagnetic radiation and/or charged particles, and an amplifier connected to the sensor for amplifying a signal from the sensor, wherein the sensor and the amplifier are fabricated on a common substrate, the arrangement being constructed and arranged to discriminate between the arrival of single or multiple incident quanta at the sensor device, wherein outputs of said sensing arrangements are combined to give the effect of a larger pixel.
30. (New) The macropixel of claim 29 wherein the outputs of the sensing arrangements are connected to a bus.